Final Report:
GGNRA Tennessee Valley Seep and Stream Amphibian Surveys
Big Lagoon Amphibian Surveys

Public version

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INTRODUCTION

The California red-legged frog (*Rana aurora draytonii*) was placed on the Federal list of threatened species in 1996 (USFWS 1996), and critical habitat was proposed in 2001 and 2004 (USFWS 2001, USFWS 2004). The Recovery Plan for the California red-legged frog calls for, among other things, safeguarding of *R. aurora draytonii* habitat, control of non-native predators, and monitoring of known populations of the frog in core areas and high priority watersheds (USFWS 2002). Golden Gate National Recreation Area (GGNRA) lies within the Point Reyes Peninsula unit of critical habitat for the California red-legged frog. Due to interest in this frog as well as due to inventory and monitoring goals of the park, a study of amphibian use of selected springs, seeps, and streams in GGNRA was designed.

The objectives of this study were to determine breeding and/or non-breeding use of selected springs and seeps by amphibians and reptiles and to describe any associations between sample site habitat conditions and use by amphibians and or reptiles. The study took place in Tennessee Valley, where spring/seep surveys and stream surveys were conducted, and at Big Lagoon, where marsh surveys were done.

Background

In Marin County, red-legged frogs typically occur in a limited number of habitat types. During breeding season, they inhabit natural and human-created ponds and lakes. These sites usually feature silt substrate, both shallow and deep habitats to accommodate egg-laying and sunning as well as avoidance of predators and summer drying, and moderate to heavy vegetation, frequently in the form of cattails or bulrushes. Breeding ponds often have open shallow areas to allow warming of littoral waters to hasten tadpole growth, and they may be bordered by trees or dense pond vegetation or feature open, grassy banks. The deep, slow-moving stream habitat sometimes used by *R. aurora draytonii* for breeding tends not to occur in Marin County.

Non-breeding season *R. aurora draytonii* habitat varies. Some frogs stay at breeding ponds all year; others disperse to logjams, rootballs, bank undercuts, blackberry thickets, animal burrows, or other refugia along streams, where they may remain until stream drying or next

year's breeding season induces them to move. Upland habitat is not widely used by red-legged frogs in Marin County other than during transit.

In 1993, Ely found California red-legged frogs using seeps and springs in other parts of GGNRA but did not find them at the seeps and springs in Tennessee Valley (Ely 1993). During the same study, he positively identified one red-legged frog in the large pond at the terminus of the Tennessee Valley drainage (Tennessee Cove Pond). Ely also surveyed the two other ponds in Tennessee Valley as well as part of the creek, but found no other red-legged frogs. In 1995 and 1998, field crews working for Gary Fellers (pers. comm.) of Point Reyes National Seashore conducted surveys at the three ponds in Tennessee Valley and found no *R. aurora draytonii* , and when Cook (1998) surveyed these same ponds in 1998, he did not find *R. aurora draytonii* either.

California red-legged frogs have been found frequently at Big Lagoon in the recent past (Ely 1993, Fellers and Guscio 2003), although in somewhat low numbers; this site features both breeding and non-breeding habitat.

METHODS

Tennessee Valley

Seep sites in Tennessee Valley were identified based on vegetation types and visual inspection (Mike Faden, unpubl. data). Sites were concentrated along Old Springs Trail and along the valley bottom in Tennessee Valley (Figure 1). See Appendix A for site photos and Appendix B and Table A for site descriptions.

Two methodological approaches were employed to investigate amphibian use of seeps in Tennessee Valley: cover board surveys and visual surveys. Fellers & Drost (1994) recommend the placement of cover boards to sample terrestrial amphibians due to their standardized size and availability to organisms combined with ease and uniformity of use. Natural cover tends to vary considerably at any given site and is often damaged or destroyed by repeated disturbance coupled with decay, so artificial cover offers a uniform, reliable, and standardized sampling technique.

Cover boards consisted of 2 x 12 x 12 inch (30 x 30 x 5 cm) boards (Fellers and Drost 1994). Four to eight cover boards were placed at each seep site, unless sites were very close together (a complex), in which case as few as two boards might be placed at a site; any seep complex had at least six boards in total.

From October 2003 through March 2004, cover boards were checked every two weeks; they were checked monthly thereafter through June 2004. Any amphibians or reptiles found under the boards were identified and replaced. Photographs were taken at the first encounter of any given species. Amphibians and reptiles observed incidentally at or near the seep sites were also recorded.

Each seep drainage which contained water was visually surveyed for red-legged frogs in October or November of 2003, before the onset of winter rains. Accessible areas were checked for amphibians up to the point where the steam became completely impassable (Figure 1).

During May and June of 2004, the main stem of Tennessee Valley Creek was surveyed according to methods outlined by Fellers and Freel (1995). The streambank was scanned with binoculars and any frogs seen were identified. If frogs jumped in before they could be identified, the bottom of the creek was scanned visually for several minutes in hopes of seeing the frog underwater and either identifying it or catching it so it could be identified in hand. Any frogs caught were weighed, measured, photographed, and released.

Big Lagoon

Red-legged frog surveys at the marsh at Big Lagoon began in January of 2004 and continued on a biweekly basis through March; monthly surveys were conducted in April and May. These consisted of diurnal surveys, most useful in detecting egg masses and tadpoles, and nocturnal surveys, most useful in detecting adult frogs. Diurnal surveys focused on egg masses during breeding season and on tadpoles thereafter.

Egg mass surveys involved walking carefully through the water so as to avoid any eggs, visually scanning the surrounding waters for egg masses. Tadpole surveys consisted of walking through and visually scanning open water and sweeping a dipnet through all vegetation. Nocturnal surveys consisted of searching for frog eyeshine using a headlamp and binoculars

(Corben & Fellers 2001), and identifying and counting red-legged frog adults or subadults. All surveys followed protocols outlined by Fellers and Freel (1994). Physical characteristics of the site were not taken due to the availability of this information elsewhere (Fellers & Guscio 2003). Surveys ended when the marsh dried in early June.

RESULTS

Tennessee Valley

No California red-legged frogs were seen at the springs and seeps in Tennessee Valley; however, numerous other amphibians were found to inhabit these microhabitats (Table 1). Amphibians encountered, in order of number of occurrences, were California newt (*Taricha torosa torosa*), California slender salamander (*Batrachoseps attenuatus*), American bullfrog (*Rana catesbeiana*), Pacific treefrog (*Hyla regilla*), rouch-skinned newt (*Taricha granulosa*), ensatina (*Ensatina eschscholtzii*), and arboreal salamander (*Aneides lugubris*). Reptiles encountered were common garter snake (*Thamnophis sirtalis*) and alligator lizard (*Elgaria* sp.).

By far the most common species encountered were the California newt and the California slender salamander. Slender salamanders were found exclusively under cover boards, while rough-skinned newts were found in or near water around the seep sites and only under cover boards during the June survey.

California newts were observed engaged in breeding behavior (amplexus) at one site, 11-10-18, where a deep pool is present. Young-of-the-year slender salamanders were observed at sites 11-10-08 and 11-10-17, and it can be concluded that this species reproduced at these sites.

Tables 2a and 2b provide cover board survey results arranged by date surveyed. Selected photographs of species encountered are found in Appendix C. Physical parameters of cover board sites are in Tables Bi and Bii.

Stream surveys at the seep/spring sites yielded no amphibians. At the time of the surveys (autumn), six of the 16 sites had water in their streamcourses. Three of these became impassable due to heavy vegetation within 100 to 150 m downstream of the seep. Three sites were

surveyable for some distance along their streamcourses. All six of these streamlets were found to offer potential refugia for *R. aurora draytonii*.

Stream surveys along the main stem of Tennessee Valley Creek yielded numerous amphibians (Table 3). Three red-legged frogs were found (Figure 2), along with 15 bullfrogs, 14 unidentified ranid frogs, and 102 California newts. In addition, two California red-sided garter snakes (*Thamnophis sirtalis infernalis*) and one racer (*Coluber constrictor*) were seen. The frogs were relatively evenly distributed along the creek west of the bridge leading to the old barn, with far fewer frogs east of this point (Figure 2).

All three of the red-legged frogs were found at pools in the stream. The pools were similar in depth and size, approximately 1.5m x 1 m in surface area and approximately 0.25m deep. Before entering the water, frogs were sitting in the midst of vegetation, 0.5m to 1m away from the water.

Big Lagoon

Few ranid frogs were found at Big Lagoon (Tables 4 and 5). No more than two California red-legged frogs were seen on any given night, and the species was seen on only four of the eight nights on which surveys took place. During diurnal surveys no *R. aurora d.* egg masses were detected, nor were any *R. aurora d.* tadpoles or metamorphs observed or dipnetted.

California and rough-skinned newts as well as Pacific treefrogs were found in abundance as eggs, larvae, and adults. No recently metamorphosed individuals were seen. The marsh was effectively dry by 8 June 2004.

DISCUSSION

Spring/seep surveys

Results of cover board surveys were generally as expected; we found terrestrial, cover-loving amphibians and a few reptiles. These sites were not expected to contain breeding habitat for red-legged frogs but were thought to offer potential non-breeding habitat along their stream courses or in pools at their sources in some cases.

Amphibian reproduction was observed indirectly at a number of sites. Reproductive behavior of California newts was observed at site 11-10-18, the only study site which contained the deep, persistent pool habitat required by newts for reproduction. Based on the number and timing of newts seen at Backdoor Pond, observed en route to another site, it is very likely that reproduction of California and rough-skinned newts occurs there, as well.

Second-year California newts were seen at sites 11-10-02, 11-10-03, 11-10-05, and 11-10-25. All of these sites are along the Old Springs Trail, distant from any ponds. These young newts, as well as adults seen at non-pond sites, very likely immigrated from elsewhere to seek cover in these wet habitats for the dry season.

Young-of-the-year slender salamanders were observed at two sites, 11-10-08 and 11-10-17. These sites are quite different from each other; 11-10-08 is in a bunchgrass seep along Old Springs Trail, and 11-10-17 is under a wax-myrtle tree in Tennessee Valley proper (see Appendix B for further detail). Judging by the large number of slender salamanders found in this study, it is certain that reproduction occurs in numerous other locations, as well.

Different survey methods are designed to sample different species, and cover board surveys are efficient in sampling terrestrial amphibians. All seep sites had abundant dense vegetation which almost certainly hid more amphibians than were observed in the study. Time-constrained surveys might have more fully revealed amphibians and reptiles at the sites, but would have been destructive to the fragile and scarce seep habitats. In addition, they would certainly have scared away any frogs present before they could be seen. The present study balanced accurate sampling and preservation of the habitat.

The impassable nature of the streams which held water during non-breeding season leaves open the possibility that they are used by red-legged frogs. In light of these facts, it is possible that *R. aurora d.* were present but not detected at some sites, since suitable habitat was present.

Ely (1993) found red-legged frogs using seep habitat at Sweeney Ridge in GGNRA. Frogs there were found in wetland areas that held some standing water; little such habitat exists in Tennessee Valley. One site, 11-10-18, featured wetland/pool habitat and was occupied by

bullfrogs, and it is possible that red-legged frogs use this site, since a number of ranid frogs there could not be identified despite repeated attempts to do so.

A number of factors may have affected the diversity and number of species encountered under cover boards. Fellers & Drost (1994) note that results of cover board surveys are influenced by time of year, time of day (or night), density of artificial and natural cover, and habitat type. In this study, the number of animals found was relatively low in autumn before storms began, and increased dramatically with the onset of rains. Numbers dropped off as spring progressed and the region dried. Cover boards were usually checked from mid-morning through afternoon. However, one check was performed at the end of the day, in near-darkness. This survey turned up the sole arboreal salamander (*Aneides lugubris*) found during the study and the only amphibian recorded all year for that site. This finding suggests that checks performed at different periods of the day may have revealed different animals under the boards. Habitat type and density of cover were similar for all sites in the study.

Not surprisingly, south-facing sites had fewer amphibians than did north- or west-facing sites.

Tennessee Valley Creek stream surveys

The finding of multiple California red-legged frogs along Tennessee Valley Creek was surprising due to the fact that only one confirmed red-legged frog has been seen in Tennessee Valley in the past 12 years (Ely 1993, Fellers unpubl. data, Fong 1996, Cook 1998). However, only one of the previous studies looked at the creek, and then only for a distance of approximately 500 m (Ely 1993). The present study looked at the creek along approximately 2.1 km, from 350 m northwest of the riding stables to 150 m east of Tennessee Cove Pond (Figure 2), and so had a higher probability of finding frogs in this habitat.

Along the reach surveyed, numerous frogs jumped in and disappeared before they could be positively identified; of the 32 ranid frogs seen along the creek, 18 were identified as either red-legged frogs or bullfrogs and 14 disappeared before identification was possible. This common difficulty in sighting frogs before they escape is due to the skittish nature of the frogs as well as to their tendency to seek well-hidden, well-protected locations once in the water.

The basking behavior of bullfrogs and red-legged frogs differs to some extent (Fellers & Freel 1995), allowing tentative comment on the identity of frogs which escaped before they could be identified. Bullfrogs tend to bask on open banks near water's edge, while red-legged frogs bask in more sheltered positions, further away from water, under vegetation, in holes, et cetera. Of the 14 frogs which could not be identified, five jumped into the creek from locations that were at least 0.25 m away from the water and obscured by vegetation. While no certain statement can be made about the identity of these frogs, it can be speculated that at least these five unidentified frogs were red-legged frogs, while the remaining nine were likely bullfrogs.

The size range of ranid frogs seen gives some indication of each species' population structure. Various sizes of bullfrogs were seen, both subadults and adults, indicating active recruitment in the population. Only adult red-legged frogs were seen, which may indicate that successful reproduction has not taken place for at least a few years. Of course, since considerably more bullfrogs than red-legged frogs were seen, the lack of red-legged subadults may be simply a function of sample size.

It is likely that the low number of red-legged frogs detected in Tennessee Valley by both present and past studies is due to the difficulty of surveying their potential habitats there. As noted above, potential refugia along streams are often heavily vegetated and thus impassable. Tennessee Lagoon Pond features some open banks but also extensive stretches of very dense emergent vegetation and deep water, which makes accurate surveys very difficult logistically. It may be easiest to locate red-legged frogs in non-breeding habitat along the creek.

If red-legged frogs breed in the Tennessee Valley drainage, the most likely habitat for successful breeding may be Tennessee Cove Pond. This large pond features dense aquatic vegetation, basking sites, water of varying depth, and perhaps most importantly, a low number of introduced predators. While the other remaining pond in Tennessee Valley (Backdoor Pond: Haypress Pond was drained last autumn) also contains excellent *R. aurora d.* breeding habitat, it is full of nonnative predators and/or competitors, most notably bullfrogs, mosquitofish, and green sunfish. Mosquitofish and bullfrogs are also known from Tennessee Cove Pond, but in much lower numbers (Ely 1993, Fellers 1995 unpubl. data, Fong 1996, Cook 1998). Tennessee Cove

Pond's depth and proximity to the ocean may create below-optimal temperatures for successful reproduction of warm-water predators, thus reducing ecological pressure on red-legged frogs.

Big Lagoon

California and rough-skinned newts as well as Pacific treefrogs were found in abundance as eggs, larvae, and adults at Big Lagoon. Few metamorphosing or recently metamorphosed individuals were seen, and it is not known whether successful reproduction occurred this year for these species, i.e. whether larvae metamorphosed before the marsh dried. The marsh was effectively dry on 8 June 2004; it was possible to walk most areas which formerly held water without encountering deep mud, which suggests it dried sometime around the end of May.

The fact that no more than two adult red-legged frogs, no eggs, and no tadpoles were seen at Big Lagoon indicates a very low population size which achieved no or very limited reproductive success in 2004. Even had egg masses or tadpoles been observed, the fact that the marsh dried by the beginning of June would have precluded metamorphosis.

The hydrologic regime at Big Lagoon has changed over time due to sediment infilling from upstream agriculture and to blockage and subsequent breaching of the mouth of Redwood Creek. In 1993, Ely described the marsh as a "pond with emergent vegetation." It has been described currently as "a cattail thicket with a few somewhat open areas with 1.0 – 1.5 m deep water (Fellers & Guscio 2003)." Suitable red-legged frog habitat at the site appears to be shrinking, and this may explain the low number of frogs and the lack of egg masses or tadpoles.

Fellers & Guscio (2003) saw radiotransmittered frogs move from Big Lagoon to both Redwood Creek and Green Gulch Creek; the frogs seen in this study likely did the same when Big Lagoon dried.

RECOMMENDATIONS & CONCLUSION

This study found potential California red-legged frog habitat in Tennessee Valley along seep drainages and occupied habitat along Tennessee Valley Creek. The study looked primarily at non-breeding habitat, found along Tennessee Valley Creek and its tributaries. It did not survey

breeding habitat, found at Backdoor Pond and Tennessee Cove Pond. The expected assemblage of terrestrial amphibians was found at springs and seeps. The study also confirms previous findings of low numbers of red-legged frogs and questionable reproductive success at Big Lagoon.

Further frog surveys along Tennessee Valley Creek during non-breeding season as well as at Tennessee Lagoon Pond during breeding season are recommended in order to monitor the population status and reproductive success of California red-legged frogs in Tennessee Valley. Mark-recapture work would give a better indication of red-legged frog population size, and radiotelemetry would elucidate frog movements and habitat use.

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TABLES

Table 1. Summary of species found at cover board sites.

site	# boards	*Taricha torosa torosa* (TATO)	*Batrachoseps attenuatus* (BAAT)	*Rana catesbeiana* (RACAT)	*Rana* sp.	*Ensatina eschscholtzii* (ENES)	*Hyla regilla* (HYRE)	*Taricha granulosa* (TAGR)	*Aneides lubugris* (ANLU)	*Elgaria* sp.	*Thamnophis sirtalis* (THSI)	*Thamnophi* sp.
11-10-02	5	2 sa	3									
11-10-03	2	2				2						
11-10-05	8	1 ad, 3 sa						1 sa				
11-10-06	5		2									
11-10-08	4		3			1						
11-10-13	8		4			1						
11-10-17	10		2 ad, 3 sa									
11-10-18	8	10		1	5		1	2		1	1	
11-10-20	4	4	2									
11-10-24	3								1			
11-10-25	4	2 ad, 2 sa										
11-10-26	6	5	2									
11-01-02	6	1 sa					2					
11-02-01	6		1									1
11-04-01	6				4				1			
haypress	4	2		3 sa			1					
backdoor	0	40		1 ad, 8 larvae								
total #	90	76	22	13	9	4	4	3	2	1	1	1

Note: If an animal was found under the same board during consecutive checks, it was counted as the same animal unless obviously a different individual. This results in a conservative count.

Table 2a. Species found at cover board sites for each date surveyed.

site	# boards	21-Oct-03	4-Nov-03	18-Nov-03	3-Dec-03	16-Dec-03	6-Jan-03	20-Jan-03	3-Feb-03
11-10-02	5							BAAT	BAAT (2)
11-10-03	2				ENES (sa)	ENES (same)	ENES (same)		
11-10-05	8								
11-10-06	5			BAAT					
11-10-08	4				BAAT, ENES	BAAT (same)	BAAT (same)		BAAT
11-10-13	8			BAAT			BAAT		ENES
11-10-17	10						BAAT (sa)		
11-10-18	8			HYRE, Rana sp (sa)		TATO (8)	TATO		TAGR (2), TATO (3)
11-10-20	4				TATO (2)		TATO, BAAT (sa)		TATO
11-10-24	3								
11-10-25	4								
11-10-26	6					TATO		BAAT	TATO (4), BAAT (2)
11-01-02	6	HYRE (2)							
11-02-01	6								
11-04-01	6							BAAT (2)	
haypress	4			RACAT (sa)	HYRE			Taricha sp (2)	inaccessible
backdoor	0			RACAT, Rana sp (sa)					TATO (4)

Abbreviations

ANLU	*Aneides lugubris* (arboreal salamander)
BAAT	*Batrachoseps attenuatus* (California slender salamander)
ENES	*Ensatina eschscholtzii* (Ensatina)
HYRE	*Hyla regilla* (Pacific treefrog)
RACAT	*Rana catesbeiana* (bullfrog)
TAGR	*Taricha granulosa* (rough-skinned newt)
TATO	*Taricha torosa torosa* (California newt)
THSI	*Thamnophis sirtalis* (California red-sided garter snake)

sp	species
sa	subadult
ad	adult

Table 2b. Species found at cover board sites for each date surveyed.

site	# boards	18-Feb-04	3-Mar-04	17-Mar-04	13-Apr-04	4-May-04	8-Jun-04	11-Jun-04
11-10-02	5	BAAT (3)						TATO (2 sa)
11-10-03	2				TATO (1 ad, 1 sa)			ENES
11-10-05	8				TATO (1 ad, 1 sa)	TATO (sa)		TATO (2 sa),TAGR (sa)
11-10-06	5							BAAT
11-10-08	4				BAAT (sa)			
11-10-13	8		BAAT		BAAT			
11-10-17	10					BAAT (3 sa, 1 dead ad)	BAAT (sa)	
11-10-18	8	Rana sp	BAAT	Rana sp		THSI	RACAT, Rana sp (2), Elgaria sp	
11-10-20	4	BAAT, TATO						
11-10-24	3				ANLU			
11-10-25	4					TATO (sa)		TATO (2 ad, 1 sa)
11-10-26	6	BAAT			3 bds inaccessible			
11-01-02	6						TATO (sa)	
11-02-01	6			Thamnophis sp	BAAT			
11-04-01	6	BAAT, TATO			BAAT			
haypress	4	inaccessible	inaccessible	inaccessible		RACAT (2 sa)		
backdoor	0	TATO					TATO (35), RACAT (8 larv)	

Table 3. Tennessee Valley Creek survey results

	11-May-04	18-May-04	18-May-04	2-Jun-04	8-Jun-04
upstrm E UTM's					
upstrm N UTM's		-SENSITIVE INFO REMOVED FROM PUBLIC VERSION-			
dwnstrm E UTM's					
dwnstrm N UTM's					
start time (local time)	1310	1052	1255	1125	1330
total time	100	37	90	100	65
air temp (ºC)	18	18.5	18.5	19.5	15.5
water temp (ºC)	16	14.5	15	13.5	14.5
wind	calm	moderate	moderate	light	strong
skies	clear	clear	clear	clear	clear
vegetation	euk, alder, willow	grasses, euk, willow, coyote brush, rubus	alder, willow, rubus	willow, alder, rubus	willow, rubus

						totals
R. aurora draytonii	1		1	1		3
R. catesbeiana	4	1	4	4	2	15
Rana sp.	2		3	2	7	14
T. t. torosa	52		20	18	12	102
T. sirtalis		1		1		2

C. constrictor		1				1

Table 4. Big Lagoon survey conditions

date	**type of survey**	**method**	**start time** (local time)	**total time**	**air temp**	**water temp**	**wind**	**skies**
6-Jan-04	diurnal	visual	1600	30	11	10	calm	cloudy
6-Jan-04	nocturnal	visual	1730	20	9	10	calm	cloudy
20-Jan-04	diurnal	visual	1100	75	15.5	11	light	mostly sunny
20-Jan-04	nocturnal	visual	1750	25	8	10	calm	clear
3-Feb-04	nocturnal	visual	1815	30	7	9	calm	clear
18-Feb-04	diurnal	visual	1025	70	17	10	light	partly cloudy
18-Feb-04	nocturnal	visual	1840	20	14	11	light	clear
3-Mar-04	diurnal	visual	1100	60	16	12	calm	overcast
3-Mar-04	nocturnal	visual	1840	40	12	12	calm	clear (2/3 moon)
17-Mar-04	diurnal	visual	1120	70	24	15	light	clear
17-Mar-04	nocturnal	visual	1910	30	14	14	calm	clear
2-Apr-04	diurnal	visual	1150	50	20	16	light	clear
13-Apr-04	nocturnal	visual	2120	15	12.5	12	calm	cloudy
4-May-04	diurnal	visual, dipnet	1100	115	19.5	21	light	clear
4-May-04	nocturnal	visual	2045	28	18	20	calm	clear

Table 5. Big Lagoon survey results

date	type of survey	*R. aurora d.*	*H. regilla*	*T. t. torosa*	*T. granulosa*	*Taricha* sp.	*Thamnophis* sp.	3-spine stickleback
6-Jan-04	diurnal			1 adult	25 adults			
6-Jan-04	nocturnal							
20-Jan-04	diurnal		4 egg masses		8 adults			
20-Jan-04	nocturnal							
3-Feb-04	nocturnal	2	chorus (8-10)					
18-Feb-04	diurnal		chorus (10-15)					
18-Feb-04	nocturnal	2	chorus (~50)					
3-Mar-04	diurnal		9 egg masses		4 egg masses			
3-Mar-04	nocturnal							
17-Mar-04	diurnal		4 egg masses	9 adults	12 egg masses			
17-Mar-04	nocturnal							
2-Apr-04	diurnal		35 tadpoles	4 ad, 9 eggs			1 subadult	
13-Apr-04	nocturnal	1	chorus (15-20)					
4-May-04	diurnal		1310 larvae	38 ad, 23 larv	35 ad, 130 larv			495
4-May-04	nocturnal	2				30		

Figure 1. Tennessee Valley seep/spring study sites. Yellow lines indicate extent of visual surveys (note that only 8 sites had drainage habitat that could be surveyed).

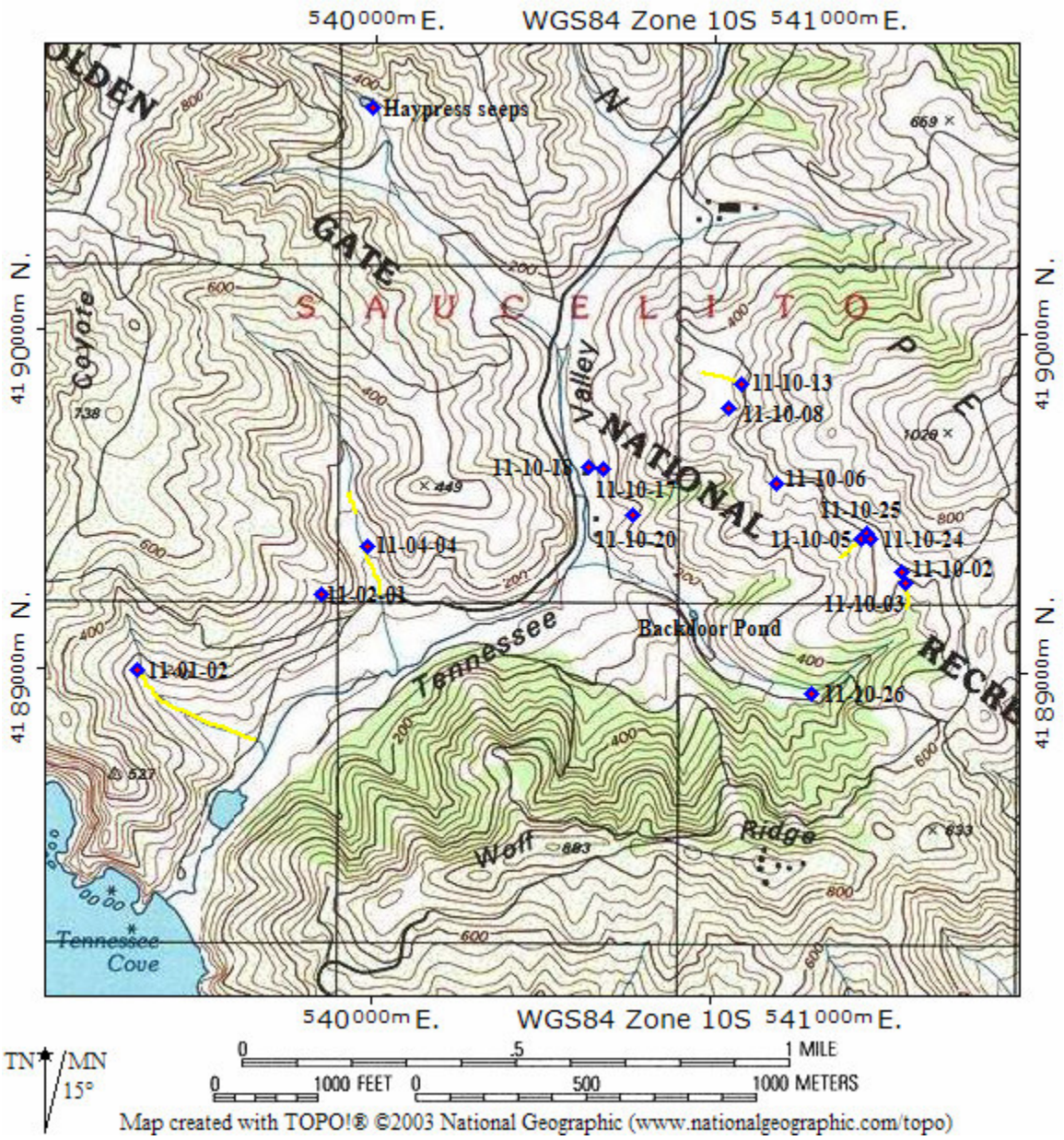

Figure 1. Tennessee Valley seep/spring study sites. Red lines indicate extent of visual surveys (note that only 8 sites had drainage habitat that could be surveyed).

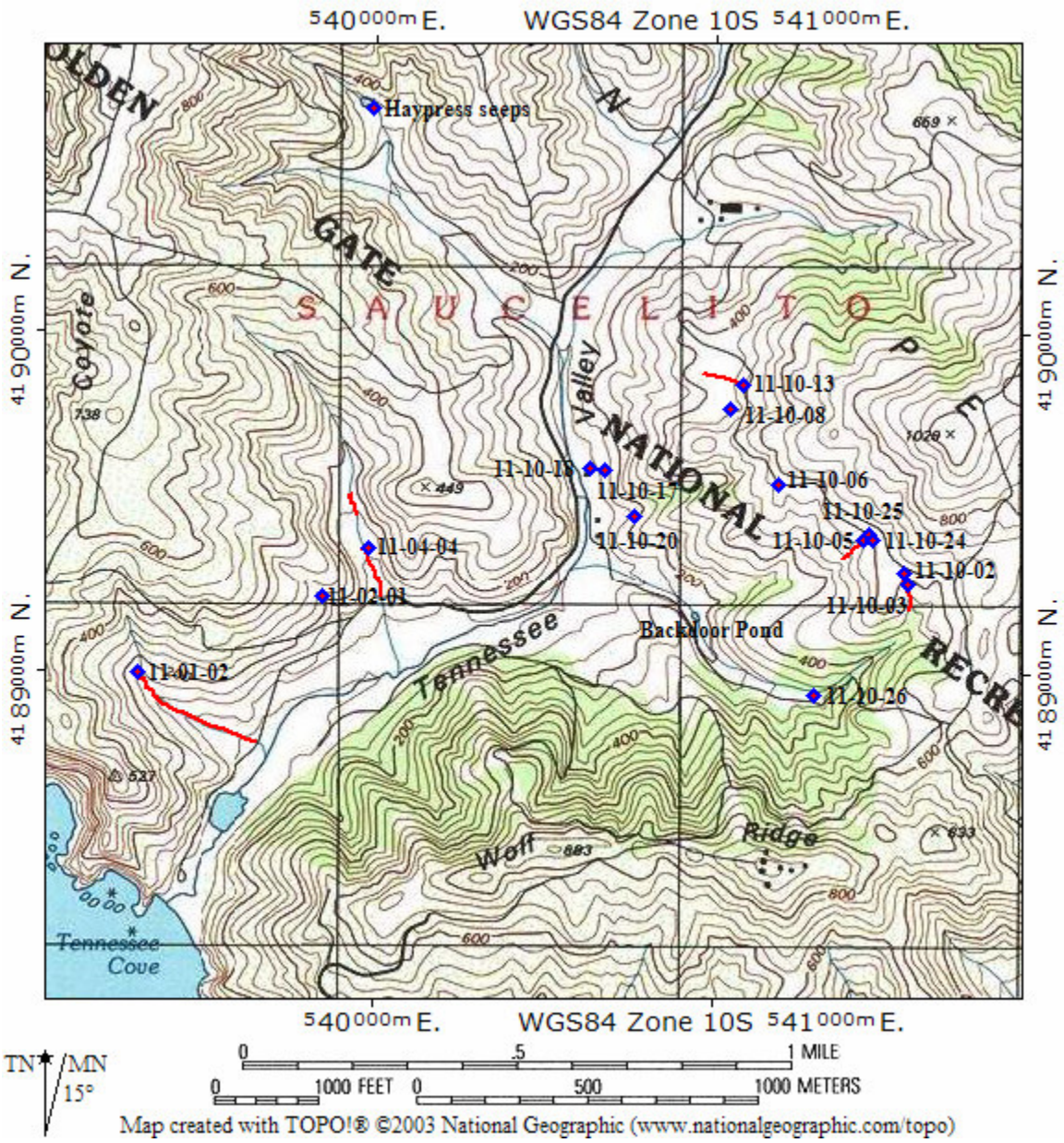

Figure 2. Tennessee Valley Creek surveys. Locations of *R. aurora d.* are designated by "RAAUx" in red. Green crosslines indicate breaks between survey dates.

-SENSITIVE INFO REMOVED FROM PUBLIC VERSION-

APPENDICES

Table A. Predominant vegetation and percent cover at cover board sites.

	% cover	predominant vegetation
11-10-02	15	pacific reedgrass, lady fern, bog rush, blackberry, slough sedge, golden-eyed grass
11-10-03	50	pacific reedgrass, lady fern, bog rush, blackberry, slough sedge
11-10-05	95	pacific reedgrass, lady fern, deer fern, wax myrtle, coyote brush
11-10-06	98	bog rush, velvet grass, poison hemlock, coyote brush, bracken fern
11-10-08	98	giant horsetail, slough sedge, lady fern, pacific reedgrass, stinging nettle, pacific oenanthe
11-10-13	95	bog rush, velvet grass, pacific oenanthe, blackberry
11-10-17	98	giant horsetail, wax myrtle, velvet grass, bulrush, tall fescue
11-10-18	90	bog rush, pennywort, watercress, pacific oenanthe,
11-10-20	85	lady fern, giant horsetail, bog rush, velvet grass
11-10-24	90	wax myrtle, pacific reedgrass, lady fern, deer fern
11-10-25	60	wax myrtle, pacific reedgrass, golden-eyed grass, lady fern, deer fern
11-10-26	90	willow, cattail, giant horsetail, cow parsnip, slough sedge, bog rush, stinging nettle
11-01-02	95	slough sedge, rush, velvet grass, giant horsetail, pacific oenanthe
11-02-01	95	bog rush, lady fern, coyote brush, sneezeweed, blackberry, poison oak
11-04-01	98	bog rush, lady fern, velvet grass, pennyroyal, tinkers penny
haypress	10	willow, bog rush, coyote brush
backdoor	n/a	willow, eukalyptus, cattail, pennywort, pond lily

Table Bi. Cover board site conditions. Descriptors represent extent of surface water (m), average depth (m), and temperature (ºC). Most surface water was in the form of streams, thus extent is most often in terms of width.

	21-Oct-03	4-Nov-03	18-Nov-03	3-Dec-03	16-Dec-03	6-Jan-04	20-Jan-04	3-Feb-04
skies	clear	clear	clear	clear	clear	overcast	pt cloudy	clear
air temp	20	18	17	15.5	16	14.5	15.5	16
ID								
11-10-02	sat'd ground	sat'd ground	sat'd ground	sat'd ground	0.05 wide	0.05 wide	0.05 wide	0.075 wide
	n/a	n/a	n/a	n/a	0.01	0.01	0.01	0.03
	n/a	n/a	n/a	n/a	12	11	11	11
11-10-03	0.1 wide	0.1 wide	0.1 wide	0.1 wide	0.125 wide	0.125 wide	0.125 wide	0.15 wide
	0.025	0.025	0.025	0.025	0.03	0.03	0.03	0.04
	14	15	13	13	12	11	11	11
11-10-05	0.1 wide	0.1 wide	0.1 wide	0.1 wide	0.1 wide	0.15 wide	0.15 wide	0.12 wide
	0.05	0.05	0.05	0.05	0.05	0.75	0.05	0
	15	16	15	15	14	12	12	11
11-10-06	none	none	none	none	sat'd ground	0.075 wide	0.075 wide	0.075 wide
	n/a	n/a	n/a	n/a	n/a	0.04	0.04	0.04
	n/a	n/a	n/a	n/a	n/a	12	11	11
11-10-08	none	none	none	none	sat'd ground	sat'd ground	sat'd ground	sat'd ground
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11-10-13	0.15 wide	0.15 wide	0.15 wide	0.15 wide	0.2 wide	0.2 wide	0.5 wide	0.5 wide
	0.05	0.05	0.05	0.05	0.05	0.075	0.1	0.1
	14	15	15	14	13	12	11	11
11-10-17	none	none	none	none	0.075 wide	0.075 wide	0.075 wide	0.075 wide
	n/a	n/a	n/a	n/a	0.02	0.02	0.03	0.03
	n/a	n/a	n/a	n/a	14	11	10	11
11-10-18	0.75 wide	0.75 wide	0.75 wide	0.75 wide	1 wide	1 wide	1 wide	1 wide
	0.2	0.2	0.2	0.2	0.3	0.5	0.5	0.5
	15	16	15	15	14	12	11	11
11-10-20	1x0.25	1x0.25	1x0.25	1x0.25	1x0.25	1x0.25	1x0.25	1x0.25
	0.1	0.1	0.1	0.1	0.125	0.15	0.15	0.15
	15	15	15	14	13	11	10	10
11-10-24	0.05 wide	0.05 wide	0.05 wide	0.05 wide	0.05 wide	0.075 wide	0.1 wide	0.1 wide
	0.02	0.02	0.02	0.02	0.025	0.03	0.04	0.04
	14	15	14	14	13	12	11	11
11-10-25	0.05 wide	0.05 wide	0.05 wide	0.05 wide	0.05 wide	0.075 wide	0.1 wide	0.1 wide
	0.01	0.01	0.01	0.01	0.015	0.025	0.05	0.05
	15	16	15	14	13.5	12	11	11
11-10-26	none	none	none	none	sat'd ground	sat'd ground	sat'd ground	sat'd ground

	21-Oct-03	4-Nov-03	18-Nov-03	3-Dec-03	16-Dec-03	6-Jan-04	20-Jan-04	3-Feb-04
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
11-01-02	0.125 wide	0.125 wide	0.125 wide	0.125 wide	0.175 wide	0.3 wide	0.5 wide	0.5 wide
	0.02	0.02	0.02	0.02	0.1	0.15	0.2	0.2
	16	17	16	16.5	15.5	11	11	10
11-02-01	0.05 wide	0.05 wide	0.05 wide	0.05 wide	0.075 wide	0.1 wide	0.1 wide	0.1 wide
	0.01	0.01	0.01	0.01	0.015	0.03	0.04	0.04
	15	16	14.5	14	14	13	12	10
11-04-01	0.35 wide	0.35 wide	0.35 wide	0.35 wide	0.5 wide	0.8 wide	1 wide	1 wide
	0.075	0.075	0.075	0.075	0.1	0.125	0.15	0.15
	16	16	15	14.5	14	11	10	10
haypress	n/a	n/a	0.05 wide	0.05 wide	0.15 wide	0.4 wide	0.5 wide	0.5 wide
			0.01	0.01	0.075	0.25	0.3	0.3
			16	15	14	12	11	11

Note: Conditions at any given site were simply noted as "unchanged" unless notable changes were evident, at times giving rise to repeat values for extent & depth over consecutive weeks.

Table Bii. Cover board site conditions. Descriptors represent extent of surface water (m), average depth (m), and temperature (ºC). Most surface water was in the form of streams, thus extent is most often in terms of width.

	18-Feb-04	3-Mar-04	17-Mar-04	13-Apr-04	4-May-04	8-Jun-04	11-Jun-04
skies	pt cloudy	overcast	clear	cloudy	clear	clear	foggy
air temp	17	16	24	17	18	16	18
ID							
11-10-02	0.075 wide	0.075 wide	0.05 wide	0.03 wide	0.025 wide		sat'd ground
	0.03	0.03	0.02	0.015	0.01		n/a
	11	11	12	12	13		n/a
11-10-03	0.15 wide	0.15 wide	0.125 wide	0.125 wide	0.1 wide		0.75 wide
	0.04	0.04	0.03	0.03	0.025		0.02
	11	11	13	11	12		13
11-10-05	0.12 wide	0.12 wide	0.1 wide	0.1 wide	0.075 wide		0.075 wide
	0.25	0.25	0.15	0.15	0.1		0.01
	12	11	12	11	12		14
11-10-06	0.075 wide	0.075 wide	0.05 wide	0.05 wide	sat'd ground		none
	0.04	0.04	0.02	0.02	n/a		n/a
	11	12	12	12	n/a		n/a
11-10-08	sat'd ground	sat'd ground	sat'd ground	sat'd ground	none		none
	n/a	n/a	n/a	n/a	n/a		n/a
	n/a	n/a	n/a	n/a	n/a		n/a
11-10-13	0.7 wide	0.5 wide	0.3 wide	0.2 wide	0.15 wide		0.15 wide
	0.12	0.1	0.03	0.05	0.03		0.03
	11	11	12	12	13		14
11-10-17	0.1 wide	0.075 wide	0.06 wide	0.025 wide	none	none	
	0.035	0.03	0.02	0.015	n/a	n/a	
	12	11	12	12	n/a	n/a	
11-10-18	1 wide	1 wide	1 wide	1 wide	0.85 wide	0.85 wide	
	0.5	0.5	0.5	0.5	0.4	0.4	
	11	11	12	12	12	13	
11-10-20	1x0.25	1x0.25	1x0.25	1x0.25	1x0.25	1x0.25	
	0.15	0.15	0.15	0.125	0.125	0.125	
	10	10	11	13	14	15	
11-10-24	0.125 wide	0.1 wide	0.075 wide	0.075 wide	0.05 wide		0.04 wide
	0.05	0.04	0.04	0.04	0.025		0.02
	11	11	12	11	12		14
11-10-25	0.125 wide	0.125 wide	0.1 wide	0.1 wide	0.04 wide		0.04 wide
	0.075	0.075	0.05	0.05	0.015		0.015
	11	11	12	12	13		15

	18-Feb-04	3-Mar-04	17-Mar-04	13-Apr-04	4-May-04	8-Jun-04	11-Jun-04
11-10-26	sat'd ground	sat'd ground	sat'd ground	sat'd ground	none	none	
	n/a	n/a	n/a	n/a	n/a	n/a	
	n/a	n/a	n/a	n/a	n/a	n/a	
11-01-02	0.75 wide	0.5 wide	0.5 wide	0.4 wide	0.4 wide	0.3 wide	
	0.4	0.25	0.25	0.2	0.2	0.15	
	11	12	13	13	14	15	
11-02-01	0.1 wide	0.1 wide	0.075 wide	0.075 wide	0.05 wide	0.05 wide	
	0.04	0.04	0.025	0.025	0.015	0.015	
	12	12	13	13	14	15	
11-04-01	1 wide	0.8 wide	0.6 wide	0.6 wide	0.4 wide	0.3 wide	
	0.2	0.175	0.15	0.15	0.125	0.1	
	11	12	12	14	14	15	
haypress	0.75 wide	0.5 wide	0.3 wide	0.3 wide	0.2 wide	0.15 wide	
	0.35	0.25	0.1	0.1	0.04	0.03	
	12	13	14	14	15	16	

Note: conditions at any given site were simply noted as "unchanged" unless notable changes were evident, at times giving rise to repeat values for extent & depth over consecutive weeks.

Appendix A:

Site Photos

1. Site 11-10-02, October 2003

2. Site 11-10-03, October 2003

3. Site 11-10-05, October 2003

4. Site 11-10-05, October 2003

5. Site 11-10-24, October 2003

6. Site 11-10-25, October 2003

7. Sites 11-10-05, 11-10-24, and 11-10-25, and their drainage, October 2003

8. Site 11-10-06, October 2003

9. Site 11-10-06, October 2003

10. Site 11-10-08, October 2003

11. Site 11-10-13, October 2003

12. Site 11-01-02, October 2003

13. Site 11-02-01, October 2003

14. Site 11-04-01, October 2003

15. Site 11-10-17, October 2003

16. Site 11-10-18, October 2003

17. Site 11-10-20, October 2003

18. Site 11-10-26, October 2003

19. Tennessee Valley Creek, view to NNE from UTM's 540599S, 4190125N (zone 10), May 2004

20. Tennessee Valley Creek, view to S from UTM's 540599S, 4190125N (zone 10), May 2004

21. Tennessee Valley Creek, view to SE from UTM's 540000E, 4188982N (zone 10), May 2004

20. Pool where *R. aurora* was found, Tennessee Valley Creek, UTM's - SENSITIVE INFO REMOVED FROM PUBLIC VERSION-
May 2004

Appendix B:

Site Descriptions

Leslie L. Wood
1080 Greenfield Rd.
St. Helena, CA 94574
707-738-2087

submitted to Darren Fong, GGNRA
5 November 2003

Tennessee Valley seeps: site summary

All sites were visited in October 2003. In most cases, the only places available to place boards were in animal trails. Every attempt was made to use the edges rather than the middle of these clearings.

11-10-02 and 11-10-03

These are bare areas in the midst of a seep on a slope. The substrate and ground cover in the bare areas consisted of mud, moss, and water-loving plants. Surrounding vegetation was almost exclusively bunchgrass in the seep itself, with grassland and sage scrub in the surrounding area (grasses, coyote brush, blackberry).

11-10-02 is ~50m S of the trail in the middle of the seep; 2 boards were placed.
11-10-03 is ~5m S of the trail, near a clump of pampas grass; 4 boards were placed.
Sites are below the 3rd bridge from the junction of Old Springs trail with Miwok Trail.

I saw no surveyable aquatic amphibian habitat at this time: no standing water, running water approximately 2-3 cm deep and 10 cm wide, and no potential pool sites. The stream channel itself is potential refugia habitat for RAAU. The cover boards may yield some terrestrial herptiles.

The downslope stream drainage for these sites angles off to the south. Directly below the seeps in contains 4 to 5 open reaches where the stream channel can be viewed before becoming impenetrable at UTM's 541582 E 4189179 N, about 125m downstream. These openings were checked for herptiles on 4 Nov 03: none seen.

11-10-05

This site is the confluence of at least 3 seeps that flow in 2 converging stream channels. The channels are choked with bunchgrass, and a wax myrtle stands in the SE channel.

Site is ~50m below Old Springs trail at the point where an old fence line intersects the trail. The only open spaces to place boards are in animal trails or above channel edges. 8 boards were placed.

Again, little surveyable aquatic habitat: no standing water, running water minimal, channels full of bunchgrasses and shrubs, no pools of appreciable size. Potential refugia habitat for RAAU.

On 4 Nov 03 the channel downstream of this and the 2 following seeps was surveyed for amphibians and reptiles at available openings in the vegetation: none were seen. Survey was possible to UTM's 541374 E 4189343 N, about 125m downstream of the seeps, after which the stream channel becomes impenetrable.

11-10-24

15m upstream to the ENE of 11-10-05, with habitat very similar to that site. A wax myrtle stands at the site's center.

Site is ~35m below Old Springs trail at the point where an old fenceline intersects the trail. 3 boards were placed.

Again, little surveyable aquatic habitat: no standing water, running water minimal, channels full of bunchgrasses and shrubs, no pools of appreciable size.

11-10-25

20m upstream to the N of 11-10-05. This site is a clearing in the grasses where scattered Sisyrhyncium sp. emerge from the soil. Mosses and other water-loving plants were present in small numbers.

The site is ~30m below Old Springs trail at the point where an old fenceline intersects the trail. 4 boards were placed.

Again, little surveyable aquatic habitat: no standing water, running water minimal, channels full of bunchgrasses and shrubs, no pools of appreciable size.

11-10-06

Stock trough adjacent to trail on SW/downhill side. Site is surrounded by bunchgrasses and wet ground but no water runs downstream at this time.

6 boards placed on 7 Oct 03; 1 discovered missing on 4 Nov 03.

No surveyable aquatic amphibian habitat seen. Possibility of HYRE in stock tank.

11-10-08

This is a very large seep area below the trail, vegetated almost entirely by bunchgrasses. Deer use is heavy.

The large size of this seep coupled with the impenetrability of the bunchgrasses necessitated placing boards in only a limited area. A deer trail leads from the ridge S of the site down into the seep; 4 boards were placed 12-15m E of where this trail enters the seep, along the accessible edges.

Little aquatic amphibian habitat can be seen at this site; cover boards may reveal use by terrestrial herptiles. This seep has no drainage at this time.

11-10-13

This is a small (2m x 3m x 5-10cm deep) pool, likely created by humans, with a seep area running downstream of it for approximately 140m. It is moderately vegetated with bunchgrasses. Deer use is heavy, as in seep 11-10-08, which is adjacent to the S.

Four boards were placed w/in 10m of pool, with another 4 approximately 40m downstream, at UTM's 541062 E 4189854 N. Access to the site is most easily obtained from the trail along the N edge of the seep.

Little aquatic amphibian habitat can be seen at this site; cover boards may reveal use by terrestrial herptiles. At this time, this seep has no drainage channel below the reach of its associated bunchgrasses. This area was surveyed for amphibians and reptiles on 4 Nov 03: no herps seen.

11-10-17

Site sits under a wax myrtle ~ 50m W of and above the old house on Tennessee Valley Rd. The seep appears to begin here. Substrate is bare or leaf-covered soil and/or rock.

10 boards were placed at this site.

Little or no aquatic amphibian habitat exists here, but cover boards may reveal use by terrestrial herptiles.

11-10-18

Very strong potential of finding amphibians here. Newts and treefrogs have already been sighted, and the spring that overflows from a bathtub creates pooly areas in the adjacent fenced field. Vegetation consists of grasses and shrubs. This is our most promising site in terms of RAAU.

Site is in field on N side of old house on Tennessee Valley Rd. 10 boards were placed.

Potential aquatic amphibian habitat, although it may be a bit shallow for RAAU reproduction. Potential non-breeding habitat for RAAU. Both day and night surveys should be done at this site.

11-10-20

1m x 0.25m pool enclosed by rock edges, on hillside above old barn on Tennessee Valley Rd. Surrounding vegetation chapparal.

Site is ~150 m E of and above old barn along Tennessee Valley Rd. 4 boards placed.

Easily surveyable. Little likelihood of RAAU at this site, although perhaps as a temporary refugia.

11-04-01

Stream channel with water intermittent along its length. Channel is cut well below ground level, ~5-8 m deep and 4-7 m wide. Water, where present, is 5-10 cm deep and 30-40 cm wide. The area of the seep appears very similar to the rest of the stream channel. Vegetation consists of chapparal, blackberry, and grasses at ground level, with grasses, bunchgrasses, blackberry and willow within the channel. Eukalyptus where stream meets Tennessee Valley Rd.

Boards were placed at sites where access to the stream bottom was possible; this occurred at 2 sites along the stream below the seep. An open bench sits above the creek on the E side, with access to the stream at approximately 175m and 200m from the road, UTM's 539976 E 4189387 N at ground

level (GPS reading not possible within stream channel). 2 boards were placed at 175m and 5 at 200m. UTM site is ~1/4 mile N of Tennessee Valley Rd.

Very nice refugia habitat for RAAU. Heard 2 HYRE calling on 21 Oct 03. On 21 Oct 03, surveyed streamcourse at open areas from seep location to old water tank N of Tennessee Valley Rd: no herps seen.

11-01-02

Stream channel with water intermittent along its length. Channel is cut well below (~4m) ground level and is 2-6 m wide. Water is 1-3 cm deep and 10-15 cm wide. Stream channel is choked with blackberry and willow, with only 3 access points along a 1/4 mile stretch. Ground level vegetation consists of grasses and chapparal. A bobcat and numerous deer have been seen.

4 boards were placed at UTM coordinates given and 2 others at wax myrtle 15m downstream. UTM site is ~1/4 mile NW of Tennessee Valley Rd.

Very nice refugia habitat for RAAU, if difficult to survey effectively due to limited access. On 21 Oct 03, stream channel was surveyed for amphibians and reptiles to the extent possible: none were seen.

11-02-01

Seep emerging from SW hillside in ravine. Coyotebrush, grasses, and poison oak. Little running water and no standing water, lots of wet ground. Aside from seep area, ravine is choked with vegetation, inaccessible.

Site is ~100m NW of the junction of Tennessee Valley Rd and the coastal trail. 6 boards were placed.

Little aquatic amphibian habitat present. Cover boards are best bet.

11-10-26

Appears to be old pond site that has silted in; there are lots of cattails but no standing water, as well as an earthen dam which appears to have been breached at some time in the past. Large bunchgrasses inhabit the seep area below the dam, interspersed with blackberry.

Site is approximately 200m SE of Backdoor Pond, 450m SE of horse stable and native plant nursery off of Tennessee Valley Rd. 3 boards were placed at and just upstream of earthen dam and 3 more ~35m downstream of dam, near end of old fenceline at N edge of seep.

Stream drainage between this site and Backdoor Pond was walked on 4 Nov 03; no access, either physical or visual, was possible along this stretch. Mosquitofish seen in Backdoor Pond.

Appendix C:

Species Photos

1. *Batrachoseps attenuatus*, site 11-10-06, November 2003

2. *Batrachoseps attenuatus*, site 11-10-13, November 2003

3. *Batrachoseps attenuatus*, site 11-10-17, January 2004

4. *Batrachoseps attenuatus*, site 11-04-01, January 2004

5. *Ensatina eschscholtzii*, site 11-10-03, December 2003

6. *Taricha granulosa*, site 11-10-20, December 2003

7. *Rana aurora* 1, Tennessee Valley Creek, May 2004

8. *Rana aurora* 2, Tennessee Valley Creek

9. *Rana aurora* 2, Tennessee Valley Creek, May 2004

10. *Rana aurora* 2, Tennessee Valley Creek, May 2004